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GROUNDWATER MANAGEMENT COMPONENT

**Curtailment of Groundwater Use for Irrigated Agriculture
in the Amman-Zarqa Basin Uplands: an Agricultural
Marketing Analysis**

by

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Executive Summary

This report presents a description of the main characteristics of the marketing system in Jordan and specifically in the Amman-Zarqa Basin (AZB) highlands, and identifies the major marketing problems facing agricultural actors in Jordan and specifically in the AZB highlands. The report also shows in quantitative and monetary terms the potential benefits that are obtained from current exports of fruits and vegetables. Finally, the report examines the expected economic and social losses that may result from water supply curtailment in the AZB region.

The highlands in general, and the AZB region in particular, play an important role in providing the country with needed fresh produce during the seasons of summer and fall. It is also the major source of exports to Jordan's traditional markets in the Gulf. During the period 1990-1995 the average quantities of fruits and vegetables delivered to national wholesale markets amounted to 787 and 287 thousand tons, respectively; the share of these deliveries which originated in the highlands averaged 59 percent for vegetables and 67 percent for fruits.

The constraints facing the marketing system of horticultural products are inefficient wholesale markets; low quality and costly packages and packaging materials; ineffective enforcement of regulations related to grading and standards; unsatisfactory refrigerated transportation systems; inadequate and inefficient cold storage and chilling facilities; the absence of effective market research and market information systems; lack of incentives for investment in marketing facilities; inadequate extension and training services; and lack of experience in post-harvest technology.

Average exports during the 1990-95 period amounted to about 293,000 tons, composed of 39 products. Five products - tomato, cucumber, lettuce, capsicum (peppers) and squash - represented about 84 per cent of total vegetable exports during 1999.

With free access to international markets many high value Jordanian products can be very profitably exported from the highlands region. Late table grape, cut flowers, and iceberg lettuce are some of the prospect crops that can be produced and exported during summer and fall. The Gulf and the EU countries import large and increasing quantities of these products during those periods.

Water is recognized as the major crucial resource in the AZB especially during the coming decades. If this economic resource is properly focused on products with highest comparative and competitive advantage, the agriculture sector in this region can significantly contribute to economic growth, job creation and rural development.

Tomatoes, cabbage, cauliflower, squash and melons are the major vegetable crops produced in the AZB. Olives, apples and peaches are the main fruit trees cultivated in the basin. Using FOB prices at the point of export, the total value of exports from the AZB was estimated at JD 11,924,896, while the total value of the marketed produce at the local market was estimated at JD 19,649,346.

The curtailment of irrigation water will definitely result in reducing agricultural production in the AZB. The values of the horticultural products produced in the AZB (for domestic consumption and exports) were estimated under the four proposed scenarios for conducting different water management options to attain the safe yield of water abstraction from the basin (refer the draft groundwater management action plan for the AZB highlands, MWI/ARD, June, 2001). If scenario #1 (reduction in pumping of 30 MCM/year) is adopted, the total losses in revenues over the period 2003-2020 is expected to reach to JD 10,625,517 of which JD 6,752,501 and JD 3,873,517 are losses from the locally marketed produce and exports, respectively. However, the expected losses of each of the other three scenarios (reductions in pumping for irrigation of 40 MCM/year) should reach to JD 14,875,724 of which JD 9,453,501 and JD 5,422,223 are expected losses due to reductions in marketed produce in the domestic markets and international markets, respectively.

The results of the analysis suggest that the government should encourage: the introduction of improved production technologies such as multi-spans and the production of higher value agricultural crops that require low water consumption; the adoption of sound marketing strategies which have the potential to improve domestic wholesale markets; the taking advantage of opportunities for increased competitiveness of Jordanian horticultural products that may arise due to the recent accession by Jordan to the WTO and the signing of many agreements and protocols with the EU and other neighboring countries; and the construction of a creative partnership with the private sector in the areas of water management, applied research and technology transfer, to assist farmers in the AZB to increase efficiency in utilizing their scarce resources and to boost productivity of high value crops.

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1. Introduction

Fresh fruits and vegetables form about 62 per cent of agricultural production in the highlands region. The fresh produce is marketed mainly through private sector oriented marketing systems. The marketing system of fresh fruits and vegetables engages the movement of produce from farmers to commission agents in one of the several wholesale markets in the main cities of the country. Amman Central Wholesale market is the largest in the country in terms of produce holding capacity, followed by Irbid wholesale market and Zarka Wholesale market. During the last three decades, five additional wholesale markets were established in the governorates of Jarash, Tafileh, Salt, Karak and Mafraq. Sixty two percent of the domestic production of horticultural products passes through the wholesale market system. The remaining 38% is either processed or marketed directly to exporters, wholesalers, catering suppliers, and consumers.

The purpose of this report is 1) to describe in brief the current characteristics of the marketing system in the Jordan and specifically in the highlands; 2) to identify the major marketing problems facing agricultural actors in Jordan and specifically in the highlands; 3) to determine in quantitative and monetary terms the potential benefits that are obtained from current exports.; and 4) to determine the expected economic and social losses that may result from water curtailment in the AZB region.

2. The current characteristics of the marketing system in Jordan and specifically in the highlands

Agricultural marketing in the highland region lacks important market infrastructure that could be found in the Jordan Valley. A series of four markets known as "Assembly Markets" serves producers in the Jordan Rift Valley. These local wholesale markets were designed and built to afford producers in the valley with marketing facilities such as grading, cold storage and packaging. The four assembly markets are found in the areas of Wadi Yabes up north, Al-Arda in the middle directorate, and South Shouneh in the south directorate and Al-Safi in the Karak Ghors. Only Al-Arda market is currently in limited operation providing producers with auctioning services during the production season. The state-owned company called the Agricultural Marketing and Processing Company (AMPCO) manages the market. This company also owns and runs the tomato processing plant located at the same site as the Al-Arda market.

Vegetable production has almost tripled in the last twenty-five years, mainly as a result of the development in irrigation projects, the introduction of protected

agriculture, introduction of new hybrid-high yielding varieties, and increased demand for fresh produce domestically and in neighboring countries. The main vegetable crops, which are produced in the highlands, are tomatoes, cauliflower squash and potatoes. Production starts in early June and continues till November of the same year. The main vegetable crops produced in the AZB region as indicated by the Rapid Survey¹ are tomatoes (18.1% in Mafraq) and cauliflower/cabbage (5.7%).

Fruit production has also showed the same trend as vegetables. The production has steadily increased throughout the period (1976-99) and amounted in 1999 to twelve times the level of 1975. The most significant increase of fruit trees production in the highland was in olive trees. Olive fruits are consumed either pickled or as olive oil.

The importance of agricultural production in the highlands can be seen through estimating the share of this area in the total amount of produce delivered to main wholesale markets in Jordan. Table 2 shows that during the period 1990-1995 the average quantities of fruits and vegetables delivered to wholesale markets amounted to 787 and 287 thousand tons, respectively. The share of the JRV production, which was delivered to these wholesale markets from these quantities, averaged 41 percent and 33 percent of total delivered vegetables and fruits respectively.

3. Exports of fresh horticultural produce

World trade in horticultural products has been expanding dramatically in the last two decades. A report by the USDA Economic Research Service in 1993, concluded the value of world trade in fruits and vegetables during 1982 to 1991, increased by 103 percent, from US\$ 30 billion to US\$ 60 billion. The report added that there is strong evidence the trend will continue.

Jordan locates at a crossroads connecting East and West, as well as Europe and Africa. The climatic conditions along with the most favorable growing conditions in the different agro-ecological zones, makes it ideal for producing a wide range of horticultural products, as long as there are enough quantities of good quality water!!.

Jordan's exports of horticultural crops reached a record number in 1982 when exports to the Gulf countries and Iraq exceeded 800 thousand tons. With declining oil revenues and an increasingly overvalued Jordanian Dinar and heavy subsidization of fruit and vegetable production in Saudi Arabia, Jordan's export declined steadily from 1982 to 1987. The 100 percent devaluation of the Dinar

¹ Ministry of Water and Irrigation, Water Resource Policy Support Project, Groundwater Management Component, "Rapid Appraisal of Groundwater Use and Users in Amman-Zarqa Basin Highlands," draft, January 2001

in 1988 produced another boom in exports of horticultural products. Total exports climbed back to 522 thousand tons in 1990.

The Highlands and the Jordan Rift Valley (JRV) are the major two sources of horticultural exports. An average of 38% of vegetable exports was produced in the JRV during the period 1991-1995. Vegetable exported quantities from the JRV fluctuated from one year to another and ranged from 46 percent of total exports in 1994 to a low of 30 percent in 1992 (table 1).

During the period 1990-1995, annual production of fresh fruits and vegetables averaged 1,500,000 tons, of which 1,189,000 tons were vegetables and 311,000 tons were fruits. The average quantity of annual exports of fresh fruits and vegetables during the period 1990-1995 constituted around 25% of the total average production of vegetables, fruits, and melons.

Exports of fresh vegetables

During the period 1990-1999, exports of fresh vegetables alone constituted about 78% of the total exports of fresh horticultural produce. Average exports during this period amounted to about 293,000 tons, composed of 39 products. Five products - tomato, cucumber, lettuce, capsicum (peppers) and squash - represented about 84 per cent of total vegetable exports during 1999 as shown in ascending order in figure 1.

Figure 1 Main exported Vegetables in 1999

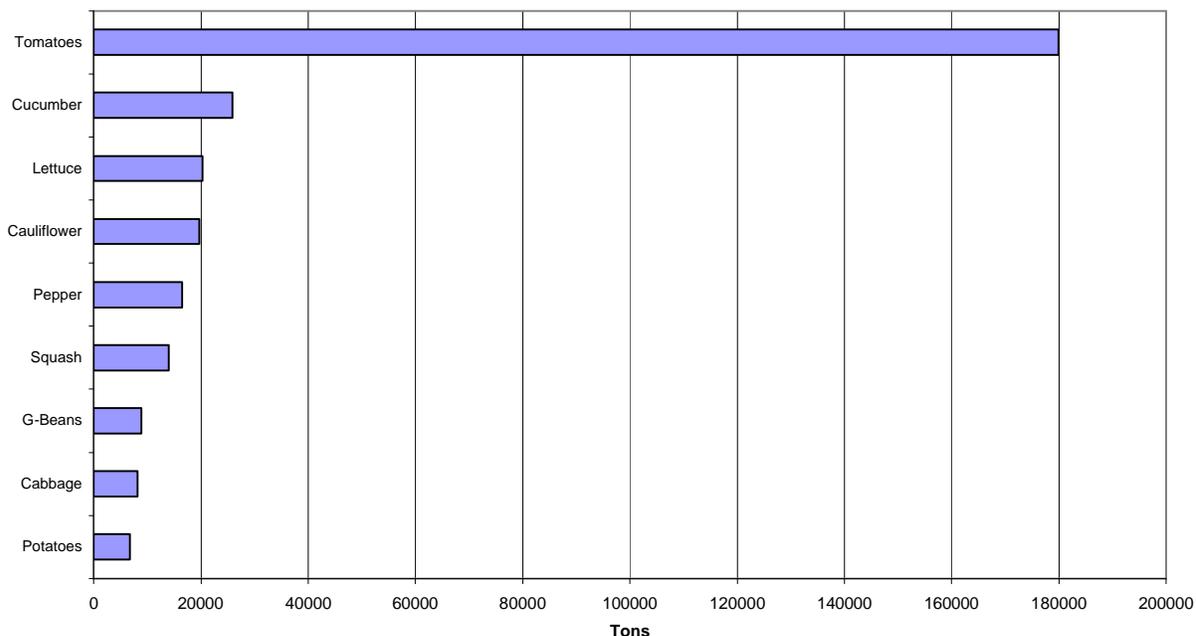
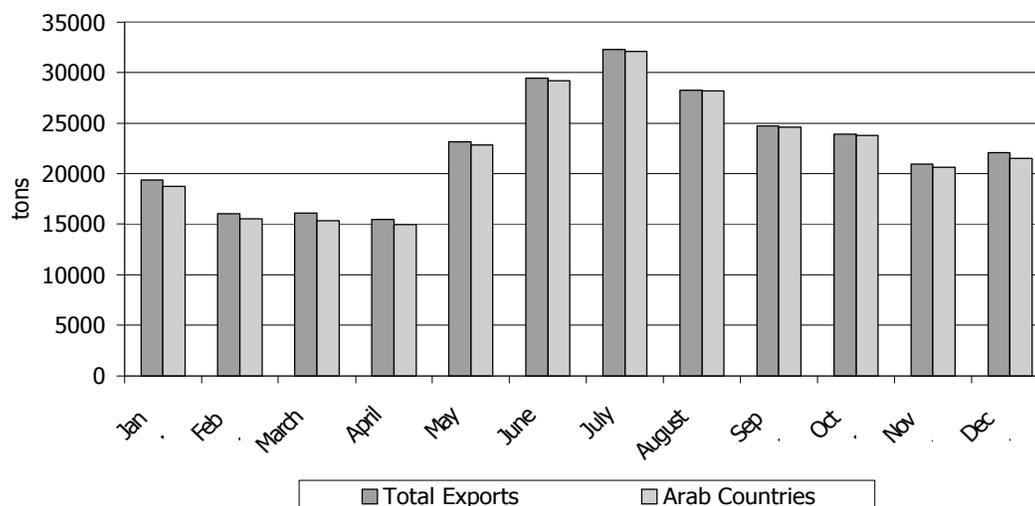


Figure 2 shows that, on average, Jordanian exports of fresh vegetables reach their maximum during the months of June, July and August. Vegetable exports

in 1994 and 1995 were below the average of 1990-1999. Total vegetable exports were 364,307 tons and 319,966 tons in 1998 and 1999 respectively, while the average during the 1990-1999 period was 271,797 tons. Figure 2 also shows that the majority of exported vegetables were to the Arab markets such as Kuwait, Bahrain, Qatar, Dubai and Lebanon.

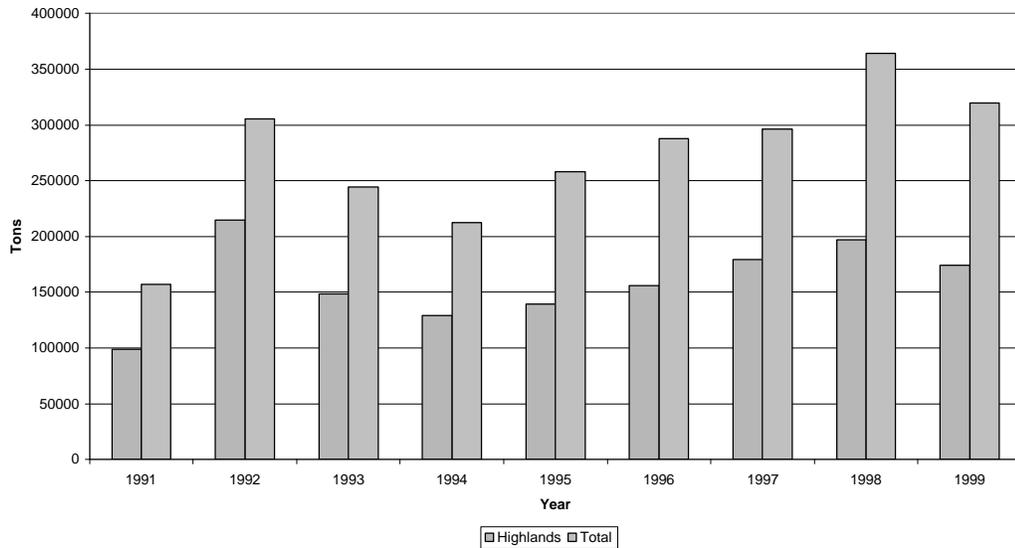
Figure 2 Average of Monthly Vegetable Exports by Destination During (1991-99)



The Saudi government halted Jordanian vegetable exports to the Saudi market since the year 1991, claiming that Jordanian vegetables are irrigated with wastewaters.

Vegetable exports from the highlands were fluctuating in the same pattern as the total vegetable exports. The highest level of vegetable exports was achieved in the year 1992. During the period 1994-1999, vegetable exports were on a steady increase. On average, vegetable exports originating from the highland represents 40% of the total national exports. Tomatoes are the major exported vegetable crop from the highland area, especially from the AZB region.

Figure 3 Total and Highlands Vegetable Exports (1991-1999)



Exports of fresh fruits

During the period 1990-1999, exports of fresh fruits, excluding melons, constituted about 17.6% of the total exports of fresh horticultural produce. Annual exports during the same period averaged about 70,950 tons. Citrus share of total fruit exports is the highest. Figure 4 shows that the highest amount of exports takes place during the months of November and December. However, fruit exports reach their highest levels during the summer months of May, June and July. Figure 4 also shows that almost all fruit exports are channeled to the Arab countries.

Figure 4 Average Monthly Fruit Exports by Destination (1991-99)

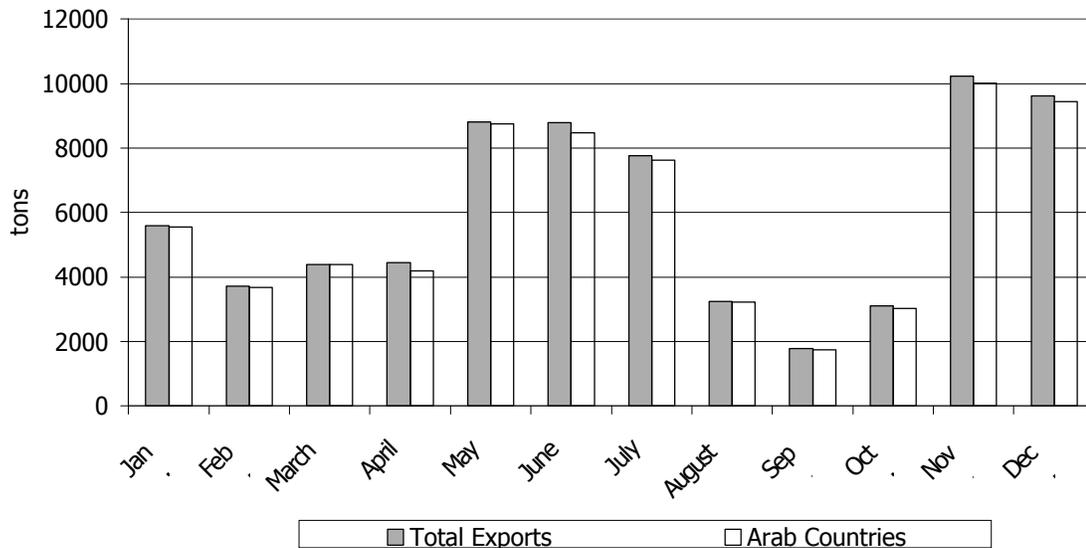
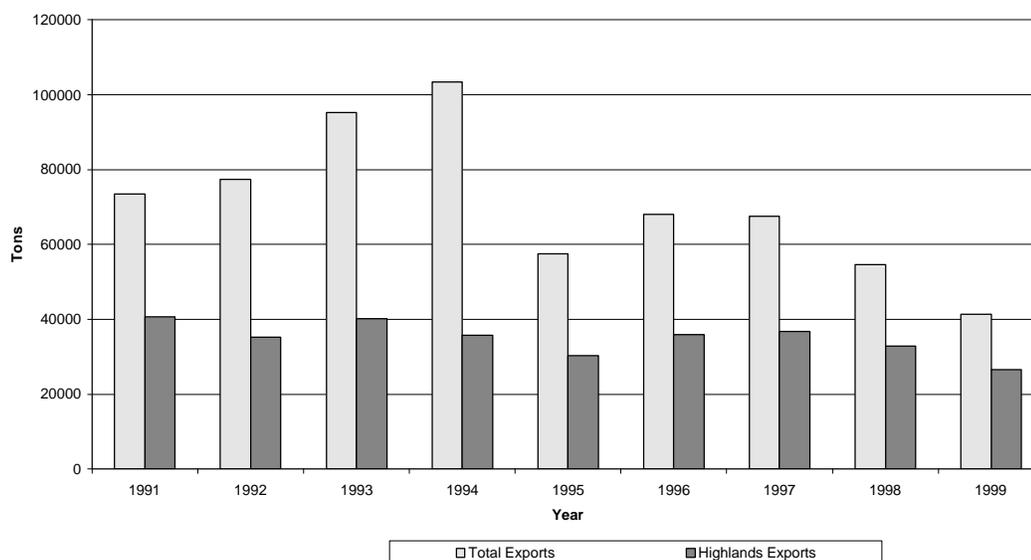


Figure 5 shows that, during 1991-1999, fruit exports have declined, especially after the year 1994. This situation has occurred due to the fact that the largest part of Jordan's exports of oranges, till 1995, was of Palestinian origin. Huge quantities of Gaza and West Bank oranges were kept in refrigerated stores in Jordan pending export to the neighboring Arab markets, or sale in the local market. These huge volumes were registered as Jordanian products. After the year 1995, these volumes were considered as imports from the Palestinian Authority and were not considered as a Jordanian exports any more.

Figure 5 Total and Highlands Fruit Exports (1991-1999)



4. Marketing channels and infrastructure for fresh horticultural produce

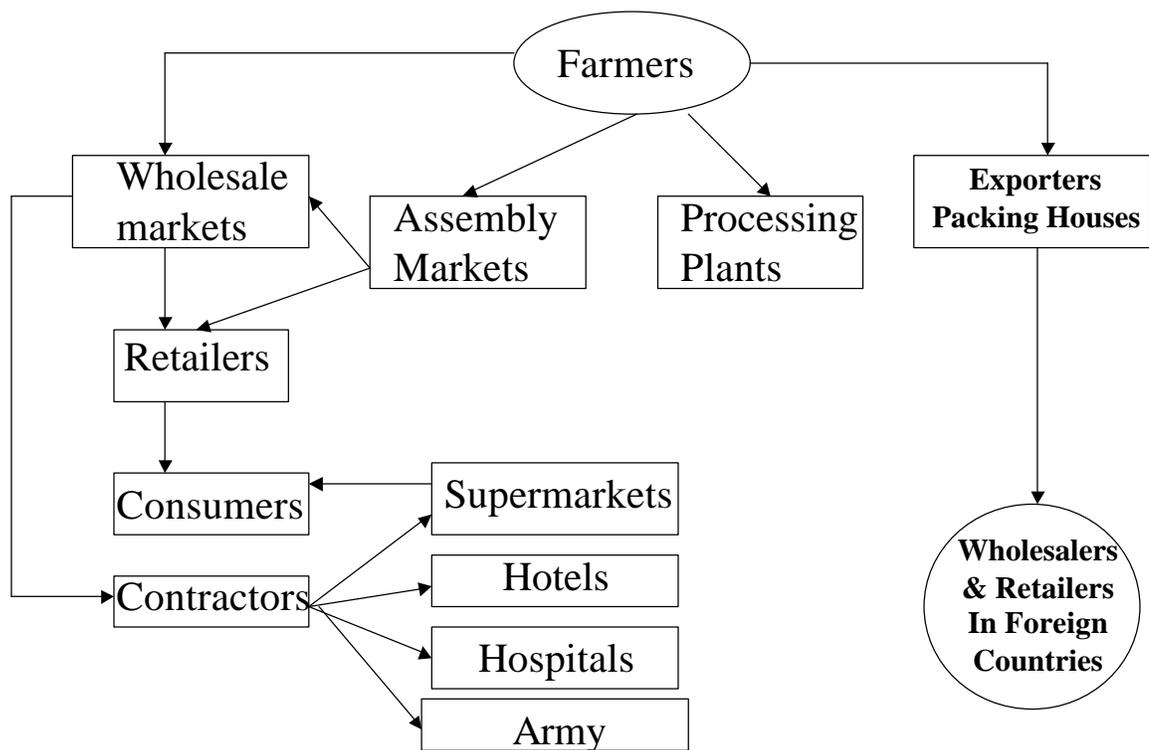
One of the objectives of this study is to review the current marketing channels and infrastructure for fresh horticultural produce in the highlands. This review will also emphasize the public and private sector institutions involved in marketing operations. The review will highlight their roles, their functions and the services they are supposed to provide as predetermined in the legislation governing their duties and responsibilities.

Marketing channels

The marketing of fresh horticultural produce in Jordan was always a private sector oriented system concern, with little exception in few situations. Figure 6 shows the marketing channels for fresh horticultural produce in Jordan. These

marketing channels involve the movement of produce to one of the wholesale markets. The produce is dispatched to a commission agent, who auctions it to wholesalers, retailers and exporters. Farmers can sell their produce on their farms, to exporters, to processors, or at roadside stands outside the major urban centers. Retailers, exporters and traders compete for the purchase of produce basically through open auctions in the wholesale markets,

Figure 6 Marketing Channels of Fresh horticultural Products in Jordan



5. Institutions related to Agricultural Marketing in Jordan

The Agricultural Marketing Organization (AMO)

The Agricultural Marketing Organization was reestablished in 1987. AMO is authorized with a wide range of responsibilities, which include the formulation, and implementation of marketing policy as well as the provision of several technical and regulatory services designed to develop the marketing system. Since it was reestablished in 1987 until now, the work of AMO has focused only on the marketing of fresh fruits and vegetables.

Agricultural Marketing and Processing Company (AMPCO)

AMPCO was initially registered as a public company. The company's shares were totally owned by the government. Then, in 1986, it was transformed from a public shareholding company to a limited liability private company, and was granted a monopoly on the import of potatoes, dry onions, garlic and apples. The main functions of the AMPCO can be summarized as follows:

- Trading in agricultural products mainly potatoes, onions, garlic and apples.
- Improving the domestic marketing system to satisfy consumers' needs in terms of packaging, quality and pricing.
- Establishing and operating processing plants for agricultural commodities.
- Pre-contracting farmers to produce certain products needed for local and export markets.
- Purchasing surpluses of agricultural produce in certain seasons and according to prices set by the government. To compensate AMPCO for its losses from such interventions, the government granted it an import monopoly on potatoes, onions, garlic and apples.
- Establishing and operating assembly markets for marketing agricultural commodities in producing regions. This objective includes establishing and operating facilities for sorting, grading, and packing.

The SHAFa plant is a tomato processing plant located in the AZB area. The plant started production in August 1994. It has a capacity of 750 tons' intake of tomatoes per 24 hours; producing triple concentrate. The product is packaged in aseptic packs and is intended for either direct export or repackaging into consumers' packs elsewhere. AMYCO owns 25% of the shares of SHAFa Company.

The Cut-Flower Producers Cooperative Association

This association is one of the most active NGOs that play a major role in marketing fresh produce in Jordan. Until the year 1997, the number of its members amounted to 26 of the 92 cut-flower growers in Jordan. The Association provides services to its members and collects fees against selling the produce of both members and non-members to ensure the income necessary to provide the needed services. The Association supplies its members with agricultural inputs at reasonable prices. It is also allowed to import the agricultural inputs it needs from abroad and to sign contracts with suppliers for this purpose.

The Jordanian Refrigerated Truck Owners Union Company

This shareholding company was established in 1987. It has 42 shareholders owning 300 refrigerated trucks, or 25% of the refrigerated trucks in Jordan

out of a total of about 1,200 trucks. The major objectives of the Union Company are:

- To serve the refrigerated transport sector through studying the problems confronting it locally and abroad, and finding proper solutions thereto
- To provide direct services to refrigerated truck owners or drivers, such as obtaining international pass documents for the trucks and cargo lists for the goods and issuing goods transport receipts.

The importance of this sector stems from the fact that it involves specialized transport that ship highly perishable products requiring low temperatures to maintain the cold chain. These trucks haul more than 98% of Jordan's fruit and vegetables exports.

6. Problems and constraints facing the marketing of fresh horticultural produce

A recent report that was prepared for the Agricultural Marketing Organization stated that the agricultural marketing system in Jordan is facing a bunch of problems and constraints that hamper government and the private sector efforts to improve agricultural marketing ². The main weaknesses of the marketing system for fresh horticultural products have resulted in the following:

1. Production surpluses and gluts, especially in certain vegetable crops. This ongoing phenomenon has forced the government to intervene with temporary reactions to remedy the situation which included the imposition of production restrictions on surplus vegetables, beginning in the 1984/85 cropping season. Several years later, the government realized that this policy was not the solution to the problem and started to eliminate the production restrictions imposed on producers.
2. Large year-to-year price fluctuations, reflecting the inability of the production and marketing systems to maintain a reasonable stability in prices. The system failed to perform its function of organizing the flow and distribution of produce, and consequently, to ensure a reasonable stability in prices.
3. Failure to sustain the growth of exports to traditional markets and to improve exports to European markets. The marketing system was not able to compete in the export markets in terms of quality and prices. Fruit and vegetable exports to Gulf markets began to decline in the early 1980s (with the exception of some years) while competing exporting countries captured part of Jordan's share in these markets. On the other hand, efforts to increase the level of exports of fresh produce to European markets were not successful. In fact, exports to European markets declined despite the new opportunities in the Eastern European countries.
4. Reluctance of private investors to invest in agricultural enterprises and

² Agricultural Marketing Organization, Export Promotion Project (1997), "Constraints on Marketing Fresh Produce in Jordan-Proposals Towards an Improved Market Structure"

vertically integrated projects. The high risk involved and the unclear investment environment lie behind the hesitation of private investors. Jordanian fruit and vegetable export businesses could be more profitable, although this is not the case at present because profit margins can be eroded very quickly by unexpected events affecting the marketing and distribution system. The small size of the export companies and the lack of vertical integration among exporters and producers, combined with high risk in the transport and distribution system, have left the agricultural sector unattractive to investors.

5. The low income of producers is one of the main outcomes of the weaknesses of the marketing system. Despite the progress farmers have achieved in production, they still suffer from low net returns. Low returns kill the incentives of farmers to continue efforts to develop production and introduce new production technologies.
6. The high percentage of post-harvest losses of fresh horticultural produce, which has been documented by a number of studies and noted by marketers. Preliminary estimates suggest that post-harvest losses exceed 25% of total production of fresh horticultural produce. Problems of poor marketing techniques and flawed handling methods are the reasons for the high rate of losses. Moreover, this situation has led to low quality and improper presentation of the produce for sale in local and foreign markets.
7. A decreasing contribution of the agricultural sector in both the gross domestic product and national exports.
8. The system's failure to fully utilize the available marketing facilities, whether these are owned and operated by the public sector (the grading and packing facilities in the Jordan Valley) or the private sector (cold-storage facilities, exporters' packing and transportation facilities)

Several studies were prepared during the last decade to tackle the main bottlenecks facing the marketing system. These studies have identified the areas of problems and constraints related to marketing functions, facilities and post-harvest technologies. These problem areas require public and private efforts and investment, without which all other efforts to develop and improve the marketing system will be ineffective. These reports concluded that the following areas need to be addressed:

- Inefficient wholesale markets;
- Low quality and costly packages and packaging materials;
- Ineffective enforcement of regulations related to grading and standards;
- Unsatisfactory refrigerated transportation system that does not meet the technical requirements for refrigerated transport of fruits and vegetables.
- Inadequate and inefficient cold storage and chilling facilities;
- The absence of effective market research and market information systems;
- The no utilization of the available laboratories for pesticide residues analysis;
- Lack of incentives for investment in marketing facilities;
- Inadequate extension and training services; and
- Lack of experience in post-harvest technology.

7. To determine in quantitative and monetary terms the potential benefits that are obtained from current exports.

Gulf countries and Lebanon are the major receivers of Jordanian fruits and vegetables. The main competitors in the Gulf market are Turkey, Egypt, Syria and Lebanon in certain periods of the year. Arab countries continued to be the major importers of Jordan's horticultural products during the period 1991-99. On average, the share of the Arab countries of total exports amounted to 98.9% and the rest (1.1-%) was exported to West and East Europe.

Table 1 demonstrates the total vegetable exports to Lebanon and Gulf markets in Saudi Arabia, Kuwait, Bahrain, Dubai and Qatar. The table shows that during the period 1990-1999, vegetable exports peaked in 1990 and dropped to the lowest level in the year 1991 following the Gulf crisis. It also shows that the highlands are the main source of exported vegetables to these markets. Vegetable exports originated from the highlands ranged from 52% to 79% of the total Jordanian exports of vegetables. Tomatoes are still the leading vegetable to these markets.

Table 2 contains the fresh fruit exports to Lebanon and the Gulf markets. The table shows that during the period 1990-1999, fruit exports peaked in 1994 and reached to the lowest level in 1995. Fruit exports from the highlands fluctuated in range of 22% to 62%. On the contrary, the proportion of fruit exports from the JRV is higher than exports from the highlands especially during the period 1990-1995. This is because the major exported Jordanian fruits are citrus which are grown only in the JRV.

The EU is the new name of what used to be called the European Community. The original EU had twelve country members. As of January 1st 1995, the European Free Trade Association countries (EFTA) were welcomed as new members in the Union. This means that the market size of the EU is about 370 million of rich consumers who are eager to pay high prices for fresh high quality produce especially during the cold winter season in this continent.

Table 1. Monthly exports of fresh vegetables during 1990-1999

Year	Jan.	Feb.	March	April	May	June	July	August	Sep.	Oct.	Nov.	Dec.	Total Exports	JRV Exports	Highland Exports	% of Highlands
1990	30510	23932	21882	7361	35819	51222	53419	47116	45019	15803	16585	15794	364462	135298	229164	63%
1991	7921	5489	4299	3065	8200	13961	19867	15528	12683	13826	14722	7348	126909	36322	90587	71%
1992	10069	8554	11132	5104	16445	42798	49001	38614	18434	23366	18127	12918	254560	64221	190340	75%
1993	10504	7889	7851	5186	17144	25815	34899	20397	122372	17836	10196	12876	292965	61450	231515	79%
1994	12657	11616	6288	4677	16886	18880	22557	22871	21194	15561	8215	4705	166107	56829	109278	66%
1995	8343	12299	11188	11227	16309	17939	19215	22535	21461	19775	15147	16541	191978	75906	116072	60%
1996	21574	14390	11050	10468	15997	22591	24294	20810	22161	19709	18718	17676	219437	91155	128282	58%
1997	14724	10189	8748	9641	11976	25419	24973	24590	24454	23492	22091	21438	221736	76716	145020	65%
1998	30030	24809	24051	20884	25528	35889	31503	25698	25354	26737	26269	30927	327679	156229	171450	52%
1999	25837	17474	18527	20670	24417	23027	27599	27492	24435	24435	22773	25840	282525	132764	149761	53%

Source: Agricultural Marketing Organization, annual reports (1990-1999)

Table 2. Monthly exports of fresh fruits during 1990-1999

Year	Jan.	Feb.	March	April	May	June	July	August	Sep.	Oct.	Nov.	Dec.	Total Exp	JRV Exp	High-Exp	% of High
1990	9570	9822	10922	7457	7159	7030	1621	289	804	669	3006	2830	61179	47760	13419	22%
1991	1274	2427	4875	6366	6142	2603	262	226	331	1559	9053	8338	43455	29422	14033	32%
1992	8436	5322	9222	3427	4827	2444	966	228	318	739	8389	7830	52149	39065	13084	25%
1993	8039	6429	8102	7821	7804	7112	2469	772	1301	2808	10634	11691	74982	49886	25096	33%
1994	12390	9760	9786	9873	7035	6059	1423	456	690	3371	10080	7846	78768	56690	22078	28%
1995	2707	1680	687	43	25	404	1727	822	1040	4039	0	12022	25196	17164	8033	32%
1996	6274	1589	1193	127	4101	2513	1717	1038	1089	3199	12777	13436	49053	26721	22333	46%
1997	5147	2288	2167	1329	4161	3065	2468	1573	398	2132	10959	11265	46951	26357	20595	44%
1998	2300	1823	1968	2153	7211	7016	6447	3455	2876	2744	6353	4602	48947	20057	28891	59%
1999	1392	982	684	1332	5985	5705	6983	1459	1985	1985	5733	4152	38377	14527	23850	62%

Source: Agricultural Marketing Organization, annual reports (1990-1999)

Jordan's exports to the EU remained marginal despite the tremendous efforts made by both the public and the private sector. Jordanian exporters will have to find seasonal market windows or niches in which they can profitably deliver products at prevailing prices during seasons of low production within the EU. In some cases, like seedless grapes in the May-July period, there may be relatively little competition in relation to the size of the potential market. In other cases, the Jordanian exporter may have to compete aggressively with other suppliers for a market already substantially saturated.

8. Expected economic impacts that may result from water curtailment in the AZB

As mentioned above, the main importers of Jordan's horticultural products are Arab countries. The Jordanian vegetable export season is very long, extending almost the year round. This phenomenon is due to the existence of different agro-ecological zones. On average, vegetable exports to Arab countries during 1991-99 were concentrated during June to November (67% of total annual exports). This means that the Highlands are the major source of vegetables to these countries. Tomatoes, cucumbers, squash, cabbage, cauliflower and melons are the main exported vegetables. On the contrary, the few shipments of fresh vegetables to European markets are concentrated during the winter months of December to April.

Table 3 shows the cropping pattern followed by the growers of the AZB region. It is clear from the table that tomatoes, cabbage, cauliflower, squash and melons are the major vegetable crops. The table shows also that olives, apples and peaches are the main fruit trees cultivated in the basin.

Table 3. Main crops in AZB highlands survey farms during (1998 and 1999)

Crop	Mafraq		Zarqa	
	% Of 1998	% Of 1999	% Of 1998	% Of 1999
Alfalfa	0.13	0.06	2.37	4.51
Barley	2.56	1.91	3.24	4.13
Wheat	0.89	0.71	0.34	0.84
Tomatoes	18.22	18.11	1.74	4.57
Potatoes	0.58	0.52	0.29	0.45
Cauliflower & Cabbage	6.49	5.74	1.64	3.17
Squash	0.29	0.62	1.34	2.78
Other Vegetables	4.51	4.61	1.18	8.02
Water Melon	7.96	6.94	0.58	0.66
Sweet Melon	1.85	2.16	0.97	1.16
Total Seasonal Crops	43.48	41.38	13.69	30.29
Apple	7.31	8.36	9.18	7.29
Peaches	8.14	7.19	6.23	4.76
Grapes	0.25	0.81	2.56	1.82
Olives	34.02	35.46	67.28	54.54
Other Deciduous	1.5	2.54	0.82	1.16
Other Nuts	5.32	4.57	0.24	0.16
Total Tree Crops	56.54	58.93	86.31	69.73

Source: Rapid Appraisal of Groundwater Use and Users in Amman-Zarqa Basin Highlands (2001)

Table 4 shows the main fruits and vegetables produced in the AZB under the different farm types. The table indicates that horticultural crops represents 85% and 80% of the total cultivated area in the AZB in Mafraq and Zarqa, respectively. Table 4 was used as the basis for calculating the total revenues from marketing the produce at the domestic and international markets.

Table 4. Cropping Pattern by Farm Type and by Zone

Crop	Tree Crop (%)	Seasonal Crop (%)	Mixed Crop %	Total (%)	Mafraq (%)	Zarqa (%)	Mafraq Du	Zarqa Du	Area (Du)
Tomato	-	40.9%	15.5%	15.2%	21.0%	4.9%	14327	1791	16118
Cauliflower/Cabbage	-	13.9%	5.8%	5.4%	6.5%	3.6%	4424	1321	5746
Watermelon	-	13.8%	4.9%	5.0%	7.3%	0.9%	4957	339	5295
Sweet Melon	-	4.4%	2.3%	2.0%	2.6%	0.8%	1787	303	2090
Potato	-	1.9%	0.5%	0.6%	0.6%	0.5%	431	174	605
Squash	-	3.0%	1.5%	1.3%	0.6%	2.5%	431	917	1348
Olive	56.4%	-	43.8%	39.9%	32.6%	52.7%	22253	19382	41635
Apple	16.8%	-	3.4%	7.0%	6.8%	7.5%	4635	2759	7394
Peach	13.7%	-	2.8%	5.7%	6.2%	4.8%	4244	1779	6023
Grape	2.4%	-	0.8%	1.2%	0.9%	1.7%	586	641	1227
Total	89.3%	77.8%	81.4%	83.3%	85.1%	80.0%	58,074	29,407	87481

Table 4 was used to estimate the total production (tons) in the AZB as a step to estimate the total revenue from horticultural production in the basin. The cultivated area was multiplied by the average yield reported by producers in the basin to obtain the total production of the main crops as reported in table 5. Table 5 shows the proportion of the production of each crop as a percentage of the total production of the whole country. The results, for instance, show that about 65% of the tomatoes produced nation-wide in the year 1999 was from the AZB. These shares were used to estimate the marketed produce in the local market and the exports. FOB prices were used to estimate the value of exports for each crop at the point of export. The table shows that the total value of exports from the AZB is JD 11,924,896, while the total value of the marketed produce at the local market is JD 19,649,346.

Table 5 was then used to derive table 6, which shows the value of the horticultural products produced in the AZB (for domestic consumption and exports) under the four proposed scenarios for conducting different water management options to reach to the safe yield of water abstraction from the basin.

Table 5. Estimating the values of marketed produce from the AZB locally and abroad

	AZB Production (ton)	Jordan Production (ton)	% of highland Prod.	Highland Exports (ton)	AZB EXPorts (ton)	FOB* JD/Ton	Total value of exports (JD)	Amm** whole-sale price	Total value of @local markets (JD)
Tomato	117663	179944	65%	94270	61642	160	9,862,698	55	3,081,162
Cauliflower/Cabbage	10342	23556	44%	14011	6151	111	682,807	140	586,706
Watermelon	21182	118967	18%	9545	1699	160	271,914	75	1,461,169
Sweet Melon	8151	14684	56%	1802	1000	210	210,049	125	893,822
Potato	1211	6767	18%	1821	326	360	117,274	235	207,923
Squash	2697	13970	19%	9262	1788	240	429,082	180	163,578
Olive	16654	93804	18%	700	124	510	63,381	367	6,066,335
Apple	11091	27670	40%	202	81	710	57,485	280	3,082,705
Peach	10842	16172	67%	200	134	890	119,333	295	3,158,702
Grape	3399	22374	15%	1237	188	590	110,873	295	947,244
Total							11,924,896		19,649,346

Source: * FOB prices were obtained from DOS international statistics

** Amman Wholesale prices were obtained from AMO records

The calculations in table 6 assume that farmers will continue with the same cropping pattern even if the government proceeds with the water curtailment options in the basin. The table clearly indicates that revenues from marketed produce in the local market and in the international markets will be reduced. The table also shows that reductions in the revenues over the period 2003-2020 in scenarios 2,3 and 4 are the same. In other words, the implications of the three scenarios are the same.

Table 7 demonstrates the annual impacts of each scenario on the total revenue in the basin. The total losses in revenues over the period 2003-2020 is expected to reach to JD 10,625,517 of which JD 6,752,501 and JD 3,873,517 are losses from the locally marketed produce and exports, respectively. However, the expected losses of each of the other three scenarios should reach to JD 14,875,724 of which JD 9,453,501 and JD 5,422,223 are expected losses due to reduction in marketed produce in the domestic markets and international markets, respectively.

Table 6. Expected revenues, of the major scenarios, obtained from domestic market and export during 2001-2020 in AZB

Scenario #	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010-2020
Scenario 1										
Revenues from domestic markets (JD)	20,510,545	20,510,545	19,160,045	18,079,644	16,999,244	15,918,844	14,916,474	14,916,474	14,916,474	13,758,044
Revenues from export markets (JD)	11,242,089	11,242,089	10,467,485	9,847,803	9,228,120	8,608,437	7,988,755	7,988,755	7,988,755	7,369,072
Total revenues (JD)	31,752,633	31,752,633	29,627,530	27,927,447	26,227,364	24,527,282	22,905,229	22,905,229	22,905,229	21,127,116
Scenario 2										
Revenues from domestic markets (JD)	20,510,545	20,510,545	18,889,945	17,269,344	15,648,744	14,028,144	12,524,589	12,524,589	12,524,589	11,057,044
Revenues from export markets (JD)	11,242,089	11,242,089	10,312,565	9,383,041	8,453,517	7,523,993	6,594,469	6,594,469	6,594,469	5,819,866
Total revenues (JD)	31,752,633	31,752,633	29,202,509	26,652,385	24,102,261	21,552,137	19,119,058	19,119,058	19,119,058	16,876,909
Scenario 3										
Revenues from domestic markets (JD)	20,510,545	20,510,545	18,889,945	17,269,344	15,648,744	14,028,144	12,407,544	12,407,544	12,407,544	11,057,044
Revenues from export markets (JD)	11,242,089	11,242,089	10,312,565	9,383,041	8,453,517	7,523,993	6,594,469	6,594,469	6,594,469	5,819,866
Total revenues (JD)	31,752,633	31,752,633	29,202,509	26,652,385	24,102,261	21,552,137	19,002,013	19,002,013	19,002,013	16,876,909
Scenario 4 (as in #3)										
Revenues from domestic markets (JD)	20,510,545	20,510,545	18,889,945	17,269,344	15,648,744	14,028,144	12,407,544	12,407,544	12,407,544	11,057,044
Revenues from export markets (JD)	11,242,089	11,242,089	10,312,565	9,383,041	8,453,517	7,523,993	6,594,469	6,594,469	6,594,469	5,819,866
Total revenues (JD)	31,752,633	31,752,633	29,202,509	26,652,385	24,102,261	21,552,137	19,002,013	19,002,013	19,002,013	16,876,909

Table 7. Expected Impacts of the major scenarios on revenues obtained from domestic market and export during 2001-2020 in AZB

Scenario #	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010-2020
Scenario 1										
Revenues from domestic markets (JD)	-	-	1,350,500	1,080,400	1,080,400	1,080,400	1,002,370	-	-	1,158,430
Revenues from export markets (JD)	-	-	774,603	619,683	619,683	619,683	619,683	-	-	619,683
Total revenues (JD)	-	-	2,125,103	1,700,083	1,700,083	1,700,083	1,622,052	-	-	1,778,113
Scenario 2										
Revenues from domestic markets (JD)	-	-	1,620,600	1,620,600	1,620,600	1,620,600	1,503,555	-	-	1,467,546
Revenues from export markets (JD)	-	-	929,524	929,524	929,524	929,524	929,524	-	-	774,603
Total revenues (JD)	-	-	2,550,124	2,550,124	2,550,124	2,550,124	2,433,079	-	-	2,242,149
Scenario 3										
Revenues from domestic markets (JD)	-	-	1,620,600	1,620,600	1,620,600	1,620,600	1,620,600	-	-	1,350,500
Revenues from export markets (JD)	-	-	929,524	929,524	929,524	929,524	929,524	-	-	774,603
Total revenues (JD)	-	-	2,550,124	2,550,124	2,550,124	2,550,124	2,550,124	-	-	2,125,103
Scenario 4 (as in #3)										
Revenues from domestic markets (JD)	-	-	1,620,600	1,620,600	1,620,600	1,620,600	1,620,600	-	-	1,350,500
Revenues from export markets (JD)	-	-	929,524	929,524	929,524	929,524	929,524	-	-	774,603
Total revenues (JD)	-	-	2,550,124	2,550,124	2,550,124	2,550,124	2,550,124	-	-	2,125,103

9. Conclusions

Production of horticultural crops is generally a profitable business especially for crops that enjoy comparative advantage. Previous studies had shown that many of the horticultural products produced in Jordan do enjoy a comparative advantage especially those produced in the Jordan Rift Valley for export purposes during the winter season. These studies have shown that the Jordan Valley has a significant comparative advantage in the production of all major horticultural crops with the exception of bananas and many types of citrus.

Preliminary results for estimating the comparative advantage for horticultural crops in the highlands showed that irrigated olives, for instant, does not enjoy a comparative advantage which implies that scarce resources such as water are not efficiently utilized in this crop.

In the absence of vigorous marketing strategies and the existence of the chronic marketing problems, which face the actors in horticultural sub sector, the following actions might be pursued:

1. Encourage the introduction of improved production technologies such as multi-spans and the production should be focused on higher value agricultural crops that require low water consumption accompanied with an outward looking strategy and diversified export marketing outlets. Labor intensive production technologies would help in minimizing the expected social impacts on the AZB communities;
2. Adopting a sound marketing strategy that has a potential to improve the domestic wholesale markets. This strategy should be based on efficiency, encompassing marketing and demand as well as the supply side of agriculture. Such a strategy would appropriately direct resource use and stimulate agricultural growth.
3. The recent accession by Jordan to the WTO and the signing of many agreements and protocols with the EU and other neighboring countries should be utilized to improve the competitiveness of Jordanian agriculture in the local market as well as in the export markets. These agreements and protocols should be considered as necessary conditions to intensify investment in those agricultural activities in which Jordan has a vigorous comparative advantage. Crops such as cut flowers, late grapes, green beans and strawberries have showed high export potentials.
4. Construct creative partnerships between the private and public sectors in the areas of water management, applied research and technology transfer to assist farmers in the AZB to increase the efficiency in utilizing their scarce resources and to boost productivity of high value crops.